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ABSTRACT

Alex F. Osborn's group brainstorming treatment remains the most frequently applied procedure for the creative generation of ideas despite considerable evidence that demonstrates its ineffectiveness. This paper synthesizes many findings that challenge the premise that Osborn's traditional "group" brainstorming treatment is the optimal method for the generation of creative ideas. The purpose of this study is to investigate whether an alternative form of group brainstorming, the IGP (Individual Orientation-Group Interactions-Personal Reflection), will facilitate a higher total production of ideas in learning groups, and more broadly, to see how the group effect may hinder idea production. This method allows participants to experience the benefits of both individual and group sessions. Participants were 108 seventh graders from an urban Midwestern public middle school enrolled in mixed ability English composition classes. One week before the study, all students were given a workshop devoted to the purposes, instructions, and procedures of the two brainstorming treatments. Next all participants were assessed for individual levels of communication apprehension. These scores were used to divide students into high or low apprehensives. Results indicated that although placing participants in groups of four dominates the existing body of research, there is no evidence that this is a necessary condition. The study found that waiting for one's turn to speak caused students either to squelch the idea or to devote time to cognitive rehearsal of their "presentation" rather than to listening. Group sessions can also cause distractions and cognitive overload. Revisions may be needed to both brainstorming methods. (Contains 20 references.) (AEF)

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Title:

Inhibitions Within Idea Generating Groups: An Alternative Method of Brainstorming

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Introduction

Alex F. Osborn's group brainstorming treatment (1953) remains the most frequently applied and instructed procedure for the creative generation of ideas despite considerable evidence that demonstrates its ineffectiveness. It is a remarkable contradiction between a popular technique and a body of non-supportive research evidence which is based on numerous replications (over 20) of the classic experiment by Taylor, Berry, and Block (1957), and which demonstrates that individuals working alone consistently produce nearly twice as many ideas as members working in groups. Thus, group brainstorming also becomes an intriguing example of a problem solving scenario where groups apparently do not out-perform individuals.

Among the explanations for inferior group performance is the effect of "group inhibition" which was originally proposed by Dunette, Campbell and Jastaad (1963). Various other experiments provide evidence that there exist many factors which can inhibit group performance and they have been tied together into a construct called "group effects". Of the many "group effects" that have been postulated by researchers, six effects have demonstrated empirical evidence of their negative effect on a group's idea production: status in the group, social loafing, task involvement, cognitive inertia, self-oriented needs, and communications apprehension (Thornburg, 1991).

Bouchard (1969) and Jablin (1977) provide evidence that test scores on the California Psychological Inventory (CPI) and the Personal Report of Communication Apprehension (PRCA), consistently relate to individual performance within groups. Individuals with low scores on these scales consistently evidence high productivity in groups and can be categorized as "Low Communication Apprehensives". Conversely, individuals with high scores on the PRCA demonstrate low productivity in groups and can be categorized as "High Communication Apprehensives". Jablin's study demonstrated that "Low Apprehensives" (LA) consistently produce more ideas in groups than do "High Apprehensives" (HA), and that HA individuals performed best when working alone. However, group composition based on communication apprehension is a factor that is frequently omitted yet evidences a negative effect on overall group productivity, as well as individual learning and satisfaction.

Another negative influence on the generation of ideas is the effect of the original brainstorming treatment itself, which places an emphasis on the group process. Diehl and Stroebe (1991) examined group communication processes and found that "production blocking" is the primary cause of low idea generation by groups. "Production blocking" is caused by the normal group convention of waiting until other members have stopped talking before they can report an idea that has occurred to them. This appears to block the production of new ideas and may be caused by limitations of short-term memory, rehearsal time, cognitive distraction or cognitive overload. Because these communication "blocks" are present in any brainstorming activity, or any group discussions, their findings have lead them to the "emphatic conclusion ... that group sessions should not be used to generate ideas".

However, there also exists evidence that the appropriate use of group interactions, as a social processing period that causes cognitive arousal, does promote increased idea generation. Studies by Dunette et. al.(1963) and Andre et al (1979), both discovered that individual brainstorming sessions became more productive when they followed a group brainstorming session. These studies demonstrated that the group process is a stimulating catalyst for the subsequent individual activity. Diehl and Stroebe propose that an individual session preceding the group brainstorming session would allow time to cognitively rehearse the development of ideas and might counter the effects of production blocking. Furthermore, the results of the studies by Bouchard and Jablin indicate that certain individuals with the personality trait of communication apprehension will perform better when allowed to work individually.

The IGP (Individual Orientation-Group Interactions-Personal Reflection) has been developed by the author as an alternative treatment for brainstorming, which combines the benefits of personal cognition and individualized creative thinking with the social stimulation of group interactions. The IGP is based on an instructional design that provides a methodology to overcome group inhibitions, assure individual expression, and promote divergent thinking. The IGP is a three step process, which differs from other brainstorming methods by structuring an individual session both before and after the group brainstorming activity. The individual sessions preceding the group session should allow for cognitive rehearsal and orientation to alleviate the effect of "production blocking". The succeeding group activity will allow for social interactions and an exchange of ideas which may serve as a "cognitive" stimulus for further processing during the final individual session. This final individual session should provide an opportunity for personal reflection and integration free from perceived "group effects", while also accommodating to the proven productivity of idea generation as an individual activity. Furthermore, the emphasis placed on individual sessions should be more comfortable and productive for "High Apprehensive" when working in groups.

Purpose and Hypothesis

This research synthesizes many findings that challenge the premise that Osborn's traditional " group" brainstorming treatment is the optimal method for the generation of creative ideas. The purpose of this study is to investigate if an alternative form of group brainstorming, the IGP, will facilitate a higher total production of ideas in learning groups. One factor that will be investigated is the personal communication apprehension level of the participants, which will be used to group the subjects as Low or High apprehensives. These homogenous groupings, in accordance to communication apprehension, will be examined for the effect that is caused by two brainstorming treatments: Traditional group brainstorming (Osborn) and the IGP brainstorming. Because the IGP places a greater emphasis on individual brainstroming rather than group brainstorming sessions, the IGP should evidence the effect of increasing the productivity of "High Apprehensive" individuals. The IGP treatment should not evidence any significant effect on "Low Apprehensives", because there is a period of group interaction, and overall the nominal (individualized) condition has proven to be more productive.

H1: Learning groups using the IGP brainstorming method will produce a higher total amount of ideas than groups participating in the traditional brainstorming method

H2: "High Apprehensive" individuals will produce an increased number of ideas using the IGP brainstorming method than will "High Apprehensive" individuals participating in the traditional brainstorming method.

Literature Review

Group Effect

Beginning with Alex Osborn's original version of his popular book, Applied Imagination: Principles and Procedures of Creative Thinking (1953), his process of group brainstorming continues to be the technique which is most frequently applied for the generation of creative ideas. Because it is believed to generate a diversity of solutions to problem-solving situations, Osborn's group brainstorming is also commonly implemented to initiate many group decision making processes. The popularization of this method is based on early laboratory studies at the University of Buffalo's Creative Problem Solving Institute which provided strong support for Osborn's claims that : "the average person can think up to about twice as many ideas when working in a group than when working alone".

With the continued interest in the processes of creativity, innovative thinking, or the formulation of challenging ideas and solutions, Osborn's brainstorming technique has important implications for learning groups. Does this method of group brainstorming offer the most effective method to promote the expression of a diversity of ideas and individual perspectives? Does this process nurture the potential for divergent as opposed to convergent thinking?

Osborn created his brainstorming procedure as a method to overcome what he believed was the primary group inhibition, public disclosure and the fear of potential group censorship. He suspected the premature evaluation of ideas and critical judgments caused a fear of social acceptance. These apprehensions blocked the free-flow of ideas, which Osborn felt is the fundamental process for unique and creative ideation. Osborn believed that a key component of the creative process is the unrestrained generation of a quantity or "fluency" of ideas. Therefore, a major purpose of Osborn's brainstorming technique was to overcome "group inhibitions" by creating a risk-free environment which valued the fluid expression of ideas with no fear of censorship. "The average group can produce nearly ten times as many ideas. in the same length of time, when ideation is unhampered as when judgment is allowed concurrently to interfere". Thus, group inhibitions which are caused by the early evaluation of ideas are the fundamental reason for his four basic rules to successful brainstorming:

1. Judicial judgment is ruled out. Criticism of ideas must be withheld until later.
2. "Free-Wheeling" is welcomed. The wilder the ideas the better; it is easier to tame down than to think up.
3. Quantity is wanted. The greater the number of ideas, the more likelihood of winners.
4. Combination and improvement are sought. In addition to contributing ideas of their own, participants should suggest how ideas of others can be turned into better ideas; or how two or more ideas can be joined into still another idea ("Hitch-hiking").

Osborn's claims were first challenged in a landmark study by Taylor, Berry and Block (1957) who conducted an experiment for the Department of Naval Research in conjunction with the Department of Psychology at Yale University. In this study, the total amount of unreplicated ideas produced by "real" interacting groups comprised of four members, is compared to the total productivity, or "ideation fluency", of four individuals who are designated as a "nominal" group.

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Nominal groups are composed of individuals who work alone to generate ideas about the same problem, and are then randomly assigned to a "nominal" group. The nominal group's performance is measured as the sum total of unique ideas generated by each individual group member and is "scored as though the members had worked together". Taylor et al concluded that:

> The performance of the twelve real groups is markedly inferior to that of the twelve nominal groups in terms of ideas produced and in terms of unique ideas produced....To the extent that the results of the present experiment can be generalized, it must be concluded that group participation when using brainstorming inhibits creative thinking.

The authors postulated that these results were the product of the group inhibitions that Osborn sought to overcome, and that despite his "rules" to prevent the preliminary criticisms of ideas:

> Nevertheless it appears probable that the individual working in a group feels less free of possible criticism by others even when such criticism is not expressed at the time than does the individual working alone. To the extent that this is true, group participation will be inhibiting. Group participation may reduce the number of effective ideas for a second reason. A given number of individuals working in a group appear more likely to pursue the same train of thought - to have the same set or the same approach to the problem - than do the same number of individuals working alone. (Taylor, Berry and Block, 1957)

Dunette, Campbell and Jastaad (1963) replicated the experiment by Taylor et al and included in their treatment that all subjects would participate in both individual and group brainstorming sessions. Their results supported the claims of the Taylor study, finding that : "Of the 24 groups, only one failed to produce more ideas under the individual condition than under the group condition" and "Only 5 of the 48 research subjects failed to produce more ideas when working individually than when participating in a group." They further stated that four persons working individually would produce 30% more ideas than individuals working together in an interacting group. Dunette et. al. concurred with the Taylor study's explanation that groups tend to "fall in a rut" and members tend to pursue a similar train of thought which results in a convergence of ideas. This conformity to a group norm, or "group-think", negates the potential productivity that stems from the diversity of individual perspectives. Dunette, Campbell and Jastaad also noted that group inhibitions cause certain individuals, who were highly productive when working alone, to have a drastic decline in productivity when working in a group condition. This led them to the conclusion that despite Osborn's rules to prevent idea discrimination through criticism:

> It appears, however, that group participation still contains certain inhibitory influences which are not easily dissipated. The "best bet" for creative thinking in attacking problems seems, therefore, to be the pooled individual efforts of many people with perhaps an initial group session to serve simply as a warm up to their (individual) efforts.
>
> (Dunette, Campbell and Jastaad, 1963)

Numerous other studies have continuously replicated the results of the studies by Taylor et. al. and Dunette et. al., evidencing that individuals consistently outperform groups at generating ideas: Vroom, V., Grant, L., and Cotton, T. (1969); Bouchard (1969); Bouchard, T. and Hare, M (1970); Street, W. (1974); Jablin, F., Seibold, D., and Sorenson, R. (1977); and Andre, M., Schumer, H., and Whitaker, P. (1979). This collection of research results supports the proposition that there does exist some "group effect". Actually, the very premise of Osborn's original brainstorming rules are based on his supposition that the group effect of public evaluation, through intra-group criticism, is a prevalent group condition and indeed inhibiting. However, these other studies indicate that despite Osborn's attempts to create a risk free and value free environment, some group inhibitory effect remained.

Bouchard (1969) continued this trail of investigations to identify this "group effect" by examining the communications apprehension levels of individuals participating in group brainstorming. "One should not forget the very strong possibility that personality type may interact with both problem-type and group-problem-solving procedure." He began one of his series of experiments by administering the California Personality Inventory (CPI) in order to examine the relationship between scores on this measure and performance in group ideation situations.

Bouchard concluded that one scale, Sociability, and one factor, Interpersonal Effectiveness, consistently related to group performance. He found that this factor was "fittingly enough developed to predict social participation" and "Thus there is no question that Interpersonal Effectiveness is a powerful predictor of problem-solving effectiveness in small groups." Through a factor analysis, Bouchard found a significant relationship of r=.89 between individuals who are highly productive at idea generation in a group situation, and who also have high scores on the CPI's Sociability scale. This agreement is in accordance with the CPI developer, Harrison Gough's characterization of high scorers on the Sociability scale as being: "outgoing, enterprising, and ingenious, as being competitive and forward, and as original and fluent in thought." Subjects with high scores on the CPI could be described as "Low Apprehensive" in regards to group interactions and are very productive group brainstormers. Bouchard provides this description of those individuals:

> High scoring subjects in the brainstorming groups have well developed social skills, are outgoing, enterprising, original, verbally fluent, fluent in thought, somewhat aggressive, dominant, and controlling, yet concerned with feelings of others. They possess self-assurance, and are spontaneous, expressive, and enthusiastic. (Bouchard, 1969)

Bouchard believed that individual personality variables must be taken into account when seeking predictions or establishing groupings of individuals. Consideration must be given to the fact that the social interactions of a group process will effect individuals differently, and this is dependent on the personal characteristics of Sociability and communication apprehension. He concluded that the group interactions between individuals of discrete communication apprehension levels, as indicated by differential CPI scores, was a significant "group effect" that could explain the reduction of a group's total ideation productivity (fluency).

Jablin, F., Seibold, D., and Sorenson, R. (1977) continued Bouchard's investigation into personal communications apprehension as being an appropriate predictor of individual proficiency/potential in subsequent group brainstorming ideation. They administered McCroskey's Personal Report of Communications Apprehension (PRCA) as a pre-test measure of each individual subject's verbal communication level. This study confirmed an earlier study by Japlin and Sussman (1976) and indicated that the PRCA had a high correlation with the CPI (r=.68). It also validated Bouchard's previous results and his inference that groupings according to levels of communication apprehension would result in significantly different scores, based on the total number of ideas produced by the group.

Japlin et.al., created homogenous groups of Low Apprehensives (LA) and High Apprehensives (HA) in accordance to scores on the PRCA. The other factor was the condition of grouping subjects into history (experience working together as a group), ad hoc (newly formed homogenous groups), or nominal groups. Their results indicate that in every condition the homogenous groups of Low Apprehensives produce more ideas than the homogenous groups composed of High Apprehensives. The fact that this is a group effect is supported by results that show no significant difference between LAs and HAs when measuring idea production in a nominal group condition. In this condition, individuals work alone and thus there is no effect caused by group inhibitions, therefore High Apprehensives should perform better in nominal groups than in interacting groups. In fact, the results of this experiment do show that HAs performed best when working alone, in the "nominal" condition. LAs (high in sociability) appear to do best in an interactive condition, and they evidenced a slight decline in idea generation while in this same, "nominal", or individualized condition.

This study also provided an important profile of High Apprehensive individuals, which served as an adjunct to Bouchard's profile of Low Apprehensives. High Apprehensives will perform best in situations where there is little demand placed on oral communication and participation. High Apprehensives can be described as tending to participate less in group discussions and having little trust in the communicative behavior of others. They normally shun competitive transactions and are generally not effective in social relationships. In social situations they are apologetic about their ideas and prefer writing to oral communication. In general: "the individual who is high in communication apprehension is one for whom the negative consequences attached to participating in an oral interchange outweigh any perceived gains".

Japlin et.al. provided additional information to support the premise that participation in a group brainstorming session will effect individuals differently in accordance to their level of Sociability or communication apprehension. It also supports the theory of a "group effect", which is manifested by reducing the productivity of HA individuals who are effected by the condition of working in a group. Japlin et. al. consistently found that High Apprehensives performed better in a nominal (individual) brainstorming condition and Low Apprehensives performed best in an interacting condition. These results suggest that how well an individual performs in a group brainstorming session appears dependent upon one's predisposition toward group interactions. The "group effect" will have a differential effect,

depending on each individual's trait of communications apprehension, which will effect their capability to perform in a group condition. This lead Japlin et. al. to the conclusion that one factor that effects group brainstorming performance is a "personality characteristic":

> Effective group brainstormers tend to be high in Sociability, low on Communications Apprehension. and generally effective in interpersonal interactions. To the extent that these traits are missing in group brainstorming, members' performance may be inferior to working alone. (Japlin and Seibold, 1978)

Brainstorming Treatment

There have been numerous other studies which have investigated the possible sources of a "group effect". Street (1974) concurred with Taylor et. al. that despite Osborn's brainstorming rules to prevent the critical evaluation of ideas until later, individuals appear to exhibit a "fear of social chastisement" by the other group members. "In interacting groups, members censor their contributions because they fear possible social disapproval by the other group members." Vroom, Grant, and Cotton (1969) further confirmed the assumptions by Taylor et. al. and Dunette et. al., that the range of different ideas in a brainstorming group appears to be limited by the "motivational pressure to conform". Nominal groups consistently produce more unique, diverse and creative ideas than do interacting groups. Vroom and colleagues interpreted these findings as an indication that: " interaction tends to result in members developing a common set in their approach to the problem, which is suggestive of 'cognitive inertia'."

Lamm and Trommsdorf (1973) continued investigations into the "group effect" and identified "production blocking" as another important aspect of this overall effect. Their findings lead them to the conclusion that: "the most important source of the inferiority of groups....is the operation of the implicit rule that only one member of the group speaks at a time". This causes a reduction in overall group productivity because "the production time theoretically available to each group member of a four-man group would be one-fourth of that available under the individual conditions."

Recent investigations by Diehl and Stroebe (1991) have advanced the investigation of "production blocking". They conducted a series of experiments which compare the difference between three "group effects" identified by previous research as being: free riding (social loafing), evaluation apprehension (fear of chastisement), and production blocking. The analysis of these experiments lead them to the conclusion that the effect of "production blocking" is the most significant influence on group performance.

Production blocking is caused by the dynamics of group interactions which causes interference with an individual's cognitive processes. The fact that another individual in the group is expressing his/her ideas often means that other group members have to "wait their turn" before they can express their thoughts. Diehl and Stroebe felt that "production blocking" effects a group member's productivity, because this "delay" in the process causes individuals to devote their short-term memory to "cognitive rehearsal" of their own ideas. Therefore, in order to prevent themselves from forgetting their own ideas while "waiting their turn", group members invest most of their cognitive energies into remembering those ideas which they previously created. This prevents them from developing new ideas because: "After all, storage space in short term memory is fairly limited, and individuals will only be able to store a small number of ideas at a given time." (Diehl and Stroebe, 1987)

Indeed, Diehl and Stroebe (1991) found the production blocking effect to account for 96% of the total variance in idea generation. They found that: "When subjects were able to report their ideas as soon as they occurred, they produced approximately twice as many ideas as when they had to wait for other speakers to finish talking."

The authors also felt that the exposure to other group member's ideas caused a "distraction-conflict" which prevented individuals from devoting cognitive energy toward the development of new, alternative ideas. Instead, mental cognition becomes devoted to understanding and interpreting the ideas of others in the group. If group members are listening to others, and simultaneously trying to take advantage of the waiting time as an opportunity to create new ideas, the resulting distraction causes "cognitive overload". Diehl and Stroebe found that providing group members with a notepad to externally store their ideas is a helpful memory adjunct. However, because the very nature of group dynamics (listening to other ideas/generating new ideas) still cause a "distraction-conflict", they recommend that: "it might be more helpful to ask subjects to develop their (written) ideas in individual sessions" before entering the group condition.

Dunette, Campbell and Jastaad (1963) found that group participation appeared to provide: "the important function of a 'warm-up' for subsequent brainstorming activity". They believed there is an important motivational aspect to group participation which is caused by social interactions and social processing. The group dynamics of exchanging

perspectives causes cognitive arousal and increased stimulation, while the very act of group participation causes increased intrinsic motivation. Their research indicates that individuals produced more information when the "group stimulation" is followed by a focused individual brainstorming session.

> A larger number of ideas or solutions was produced when subjects experienced the individual brainstorming after having experienced the group session, than when they "went in cold" to the individual session.
>
> (Dunette, Campbell and Jastaad, 1963)

Andre, Schumer and Whitaker (1979) also found that subjects in their experiment produced more ideas when the group brainstorming preceded an individual session. Their results suggest that: "while group experience inhibits creativity for discussed items it may serve as a spur to individual creativity for subsequent items." They believe that this is caused by a "lowering of the psychological barriers" in the individual by exposing them to the "wild ideas of other group members". This, in effect, lowers the threshold of expected social chastisement and provides a safer atmosphere for individual creativity. A group norm becomes established that allows individuals to be more receptive to novel or unusual ideas, and this stimulates the individual to more freely express themself.

IGP Brainstorming Technique

This previous research suggests that perhaps Osborn's traditional group brainstorming process itself needs to be altered, in order to take advantage of both the individual process and group process of idea production. Most of the research indicates that the most productive generation of ideas occurs when individuals brainstorm by themselves and then combine their ideas in a "nominal group". I am proposing an alternative method of brainstorming called the IGP (Individualized-Grouped-Personalized), which will allow the participants to experience the benefits of both individual and grouped sessions. It is similar in every way to Osborn's original brainstorming rules, except that it allows for an individual session both before and after the group brainstorming activity. The overall design of the IGP begins with an individual session, followed by a group session, and ending with a follow up individual session. This allows for more emphasis on the individual sessions which have proven to be more productive, but also uses the group activity to stimulate further individual processing.

It is hoped that the individual sessions preceding the group session will allow for cognitive rehearsal and orientation that may alleviate the effect of production blocking. This will also allow the group brainstorming session to incorporate the Nominal Group Technique developed by Van de Ven and Delbecq (1975) which suggests that allowing individuals to write down their ideas before a group session facilitates: "self-disclosure of ideas, even by less secure members who may hesitate to bring some problem dimension before the group in the conventional interacting situation."

The IGP should also benefit from the "warm-up" of having a group session before the final individual session. This will serve to stimulate individual productivity as a function of the dynamics of group interactions and the cognitive arousal caused by exposure to new and challenging ideas. The final individual session should benefit from the arousal and increased intrinsic motivation caused by the previous group participation. However, it will also allow individuals to be free from the distraction-conflict that is often caused by group interactions and which results in cognitive overload.

It should also be noted that the IGP is constructed to allow for individual differences; the personality characteristics that are indicated by personal communication apprehension scores. The group session should be conducive to "Low Apprehensives" who generally produce more ideas when in a condition of interpersonal interactions. While the overall emphasis on individual sessions will be less intimidating and more productive for "High Apprehensive" individuals, who frequently find the group process less comfortable and productive. Overall, the IGP attempts to incorporate the way individuals learn by social interaction, as well as the way learning occurs through the process of personal cognition.

The purpose of this experiment is to determine if an alternative method of brainstorming, the IGP, will enable learning groups to increase the total amount of ideas they produce. By integrating the proven benefits of an individualized (nominal) condition with the suspected cognitive benefits of group interactions, the IGP should provide a more productive brainstorming condition than does the traditional group brainstorming method. The IGP is an attempt to synthesize the process of social learning with the process of individual creativity. This not only takes into account learner preferences, as evidenced by their communication apprehension traits, but also provides individual sessions to alleviate the apparent variety of "effects" associated with group participation.

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The PRCA test has seldom been used with younger learners, but it should provide valuable information in regards to individual learning styles that deserve consideration. I am blocking for levels of communication apprehension to control for their documented differences in regards to group brainstorming ideation. I also want to examine if the two different types of brainstorming treatment evidence any differential effect in regards to individual levels of communication apprehension. It is suspected that the IGP treatment should enhance the productivity of High Apprehensives because of the IGP's emphasis on individual sessions. However, the IGP should also improve overall group productivity by synthesizing the creative experiences of both group processing and the individual process of reflection or personal cognition.

Methods

Subjects

Participants were 108 seventh graders (49 female/59 male) from an urban Midwestern public middle school. All were enrolled in mixed ability English composition classes, where group brainstorming is introduced as a technique for the creative generation of ideas.

Materials

A workshop was created to provide a training session on the activity of brainstorming, as well as present practice exercises using both the brainstorming treatments. The "Traditional Rules of Brainstorming" were based on Osborn's four main concepts:

1. Do not criticize any ideas
2. All types of ideas are encouraged - the wilder the better
3. The goal is to create as many ideas as possible
4. "Hitch-hiking": using a combination of someone else's ideas to create new ones is encouraged. The facilitator will write down all the group ideas.

The "Rules of the IGP Brainstorming" were based on the above four concepts and included the following procedures:

1. You will first brainstorm individually for 5 minutes. During this session there will be no talking and you need to write down all the ideas that you think of. Keep your "idea sheet".
2. At the end of 5 minutes the facilitator will come around and bring you together in your group. At this time draw a line across the page below your last individual idea.
3. You will be in the group for 10 minutes and at this time you are encouraged to talk with other group members, share your ideas, and create new ideas with the group. The facilitator will write down all the group ideas.
4. At the end of the group session you will return to your seats and individually brainstorm. Use any group ideas to help create new ones (hitch-hike). Write down all the ideas that come to you, including any "repeats" on your "idea sheet". At the end of 5 minutes the facilitator will collect your idea sheet.

The PRCA pre-test is a valid and reliable(.93) measure of communication apprehension (McCroskey, 1970,1985) and an indicator of individual productivity in brainstorming groups (Jablin et. al., 1977). The problems used in this research have also been validated as appropriate brainstorming exercises (Thornburg, 1991; and Renzulli, Owens, and Callahan, 1974).

Design and Procedures

One week before the study, all students were given a workshop devoted to the purposes, instructions and procedures of the two brainstorming treatments. Next all participants were administered the PRCA to assess their individual levels of communication apprehension. The PRCA scores were used to divide students into high or low apprehensives based on their scores in relationship to the test median (60). Participants with scores at or above this median were categorized as "High Communication Apprehensives". Members from these two apprehension categories were then randomly assigned to homogenous groups of four, and these groups were randomly assigned to either a Traditional (Osborn's groups) or IGP brainstorming treatment in a 2x2 factorial design.

During the individual brainstorming sessions of the IGP, subjects wrote down all their ideas; during all group sessions the subjects orally shared their ideas and those were recorded by multiple raters. The subjects were asked to generate as many ideas as possible in 20 minutes on two exercises which have been previously validated as adequate for full ideation (Bouchard, 1969 and Diehl and Stroebe, 1991). The final group scores are based on "fluency" - the total number of unreplicated ideas that each group generated within the 20 minute period.

Results

The results were subjected to an analysis of variance for uneven cell size with a one-way ANOVA. Blocking was done for levels of communication apprehension from the results of the PRCA pre-test (49 HA and 59 LA). Of the 49 HA individuals the majority were found to be female(30/49). The ANOVA produced no significant differences for Treatment $F(1, 22)=2.38$, $p<.089$; Communication Grouping $F(1, 22)=1.50$, $p<.236$; Interaction $F(1, 22)=0.855$, $p<.367$.

Discussion

While there were no statistically significant results the study did provide some interesting findings that will be useful for future studies. Although placing participants in groups of four dominates the existing body of research, there is no evidence that this is a necessary condition, except that it concurs with the precedent set by Taylor et. al. (1957). Using groups of four students greatly diminished the overall power of this study and subsequent research has indicated that smaller group sizes may prove to be equally valid (Thornburg, 1991; Renzulli et. al. 1974). This may have particularly influenced the significance of the IGP treatment effect because the means for the two brainstorming exercises all appear to indicate a difference regardless of the communication level: Question 1 - IGP/81.6 vs. Traditional/62.6; Question 2 - IGP/84.4 vs. Traditional/ 69.0. Surprisingly, no difference was found between the two communication levels, however the LAs did consistently outperform the HAs and the lack of statistical power may have also influenced this outcome. There was an indication of a slight trend, where the difference between the means of HAs and LAs diminished from the first and second exercise (Q1 - HA/61.7 vs. LA/84.6 and Q2 - HA/72.3 vs. LA/81.9). This might suggest that HA's become more socially comfortable over time which positively effects their performance.

Another factor which may have diminished the effect of the IGP was the length of time given for the treatment. In its original design, the IGP would allow more time between the three sessions. The first individual session would occur a few days before the group session, providing an opportunity for the individual generation of ideas as well as an advanced organizer. After the group brainstorming session, participants would be given a copy of all the ideas generated up to that point and then allowed a few days for further ideation. It is believed that the twenty minute sessions provided in this research study is an "artificial" constraint on the cognitive processes of orientation and reflection. However, the longer treatment would be problematic in a school class setting and little control on providing equal "time on task" between the two treatments. Future research might be conducted using the "ideal" IGP treatment condition and allowing for three separate group sessions, even though this might mean sacrificing experimental control of the time variable.

The results of the PRCA pre-test suggests that gender would be an interesting factor to investigate both in regards to communication apprehension and brainstorming performance. The age and nature of this population sample may also have adversely effected the research results. Previous brainstorming studies have usually been performed with an older population, who are more familiar with brainstorming and group work. Future studies may also benefit from more contextually relevant brainstorming exercises concerning personally meaningful problems and a vested interest in the successful discovery of potential and alternative solutions.

Although it was a purposeful intention of this study to examine brainstorming in a "natural" social setting, and thus avoid the confounding effects of an electronically mediated experience, another area for future investigation is the effect of various computer based technologies (Networks and GDSS). Many studies have indicated the effectiveness of a GDSS-type interface and perhaps merging these technologies with a strategy such as the IGP will further enhance idea production. Some advantages of a computer interface would be their capability to overcome various forms of group inhibitions: an anonymous individual condition to negate the effects of evaluation apprehension; an efficient management of the group process through the synchronous expression of ideas (production blocking); an efficient record keeping mechanism of individual contributions. However, since many schools, organizations and groups do not have access to this type of equipment it still remains pertinent to observe the effects of the IGP without an electronic system.

As an area of research, group brainstorming is an interesting example of a popularly employed group activity which is widely believed to increase productivity, yet these actual performance gains are unsubstantiated by existing research. Group brainstorming is a classic paradox concerning the appropriate use of group vs. individual efforts, and thus it reveals many questions as to "what" factors have a negative effect on group performance. Is it the inherent "nature of the task" itself, and what are the specifics of the task demands that perhaps makes a particular activity more appropriate and productive for individual endeavors as opposed to group work? Is it the various effects of group composition and individual differences on group performance? Are the negative influences of "group effects" an inevitable consequence of group work and what group management strategies can be developed to overcome these problems?

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